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a 3-D mesh object layer analyzer for receiving a 3-D mesh and dividing an input 3-D mesh into one or more independent mesh object layers;

one or more mesh object layer coders for independently coding and transmitting one or more mesh object layers; and

one or more mesh object layer decoders for decoding one or more independent mesh object layers which are independently coded and transmitted, to obtain one or more independent mesh object layers.

18. An independent and progressive 3-D mesh information coding/decoding apparatus as claimed in claim 17, further comprising a 3-D mesh object layer synthesizer for synthesizing one or more independent mesh object layers and removing redundant information to reconstruct the original 3-D mesh.

19. (Amended) A progressive 3-D mesh information coding/decoding apparatus comprising:

a 3-D mesh object layer analyzer for receiving a 3-D mesh, dividing an input 3-D mesh into one or more mesh object layers, and again dividing each mesh object layer into a plurality of independent mesh components;

a plurality of mesh component coders for independently coding and transmitting the plurality of independent mesh components; and

a plurality of mesh component decoders for decoding the plurality of mesh components which are independently coded and transmitted, to obtain a plurality of independent mesh components.

REMARKS

By way of this Amendment, claims 1, 3, 6, 9, 13 and 17-19 have been amended. Independent claim 1 has been amended to recite that each of the divided mesh components correspond to a different partition of the 3-D mesh. Support for this amendment can be found throughout the disclosure as originally filed, for example, in pages 6-12 of the specification and Figures 2-12, especially figures 9-12c and the supporting text. In claim 3, minor changes

have been made as to informalities and step (a2) has been amended to recite "dividing the one or more mesh object layers each into the plurality of mesh components." Claims 6, 13, 17 and 18 have been amended only as to informalities. Independent claim 8 has been canceled without prejudice or disclaimer. Claim 9 has been rewritten in independent form to include all the features of originally filed independent claim 8. Claim 19 has been amended to recite that the plurality of mesh component coders are for independently coding and transmitting the plurality of independent mesh components. Accordingly, claims 1-7 and 9-20 remain pending in the application. Favorable reconsideration is respectfully requested.

Applicants gratefully note the Examiner's acknowledgment of Applicants' claim for priority under 35 U.S.C. §119 and receipt of the certified copies of the prior foreign applications submitted September 15, 1999.

All Claims Define Allowable Subject Matter

Claims 1-3, 8-9 and 19 stand rejected under 35 U.S.C. § 102(e) as allegedly being anticipated by U. S. Patent No. 6,262,737 to *Li et al.* (hereinafter, *Li*). Applicants traverse this rejection for the following reasons.

To the extent that the Office may consider this rejection applies to amended independent claim 1, it is respectfully submitted that *Li* fails to anticipate claim 1 at least because *Li* fails to identically disclose the novel combination of each and every feature recited therein. Specifically, the invention, as embodied by amended independent claim 1, is directed to a progressive 3-D mesh information coding method comprising the steps of dividing a 3-D mesh into a plurality of mesh components, wherein each of the mesh components correspond to a different partition of the 3-D mesh; coding each of the plurality of mesh components; and multiplexing the plurality of coded mesh components into a compressed bit stream and transmitting the compressed bit stream.

In support of the rejection, the Office Action alleges that "*Li* ... discloses dividing 3-D mesh into a plurality of mesh" (see the Office Action, page 2). Applicants initially note that this statement by the Office Action does not correctly characterized claim 1 because claim 1 specifically recites "a plurality of mesh components." The Office Action then appears to allege that the claimed mesh components correspond to *Li*'s separately encoded topological and geometrical data of a 3-D mesh. However, *Li* does not discuss or suggest that these data

are divided into a plurality of mesh components, wherein each of the mesh components corresponds to a different partition of the 3-D mesh. To the contrary, *Li* appears to disclose that the coding and decoding of topological and geometrical data is performed for an entire 3-D mesh. The claimed feature of dividing a 3-D mesh into a plurality of mesh components is not mentioned or suggested in *Li*. Moreover, because the entire mesh appears to be transmitted in *Li*, the encoded topological and geometrical data described in *Li* would also appear to correspond to units of the entire mesh data, and not to mesh components that correspond to different partitions of a divided 3-D mesh.

The Office Action rejected claim 19 as allegedly being anticipated by *Li* for the same reasons given with respect to claim 1. In response to this allegation, Applicants respectfully submit that *Li* fails to anticipate claim 19 because *Li* fails to disclose the novel combination of every feature recited in claim 19.

Amended claim 19 defines a progressive 3-D mesh information coding/decoding apparatus comprising a 3-D mesh object layer analyzer for receiving a 3-D mesh, dividing an input 3-D mesh into one or more mesh object layers, and again dividing each mesh object layer into a plurality of independent mesh components. Claim 19 further requires a plurality of mesh component coders for independently coding and transmitting the plurality of mesh object layers, and a plurality of mesh component decoders for decoding the plurality of mesh components which are independently coded and transmitted, to obtain a plurality of independent mesh components.

Li describes that a plurality of mesh layers may be formed from a 3-D mesh to provide incremental convergence from a coarse (base) version of a mesh to the original 3-D mesh (see *Li*, column 11, line 50 to column 13, line 49). However, *Li* does not mention or suggest a 3-D mesh object analyzer for dividing an input 3-D mesh into one or more mesh object layers, and again dividing each mesh object layer into a plurality of independent mesh components. While *Li* discusses separately encoding topological and geometrical data, this does not necessarily imply, in the context of a 3-D mesh, that the topological data is independent from the geometrical data. Moreover, *Li* does not disclose a plurality of component coders for independently coding and transmitting the plurality of independent mesh components. *Li* instead discloses progressively forming one new layer from a previous layer. According to

Li, the convergence from a coarse version of the mesh to an original mesh representation is performed by a *sequential* operation in which these layers are consecutively processed (see *Li*, column 13, lines 43-49). Because *Li* fails to disclose these features of claim 19, Applicants respectfully submit that *Li* cannot anticipate claim 19.

The Office Action rejected claims 8-9 as allegedly being anticipated by *Li*. Claim 8 has been canceled without prejudice or disclaimer, thereby rendering the rejection of this claim moot. Claim 9 has been amended to include the features of independent claim 8.

The Office Action alleges that *Li* anticipates claim 9 because of *Li* discloses "removing redundant information (col. 5, lines 57+)" (see the Office Action, the top of page 3). Applicants disagree. Claim 9 requires extracting one or more independent mesh object layers from a 3-D mesh, independently coding and transmitting the one or more mesh object layeres, obtaining one or more independent mesh object layeres by decoding one or more of the independently coded and transmitted mesh object layeres, and reconstructing the original 3-D mesh by collecting the independent mesh object layeres and removing redundant information. Thus, claim 9 at least requires removing redundant information in a step involving reconstruction of a 3-D mesh. In clear contrast to this claimed feature, the passage of *Li* cited by the Office Action discusses removing data redundancy during an encoding process. See *Li*, column 5, line 65 to column 6, line 1:

The approach adopted currently for geometry compression is to use local prediction to remove data redundancy and then apply a quantization scheme and a run-length coding method to encode the prediction error (emphasis added).

Hence, the portion of *Li* cited by the Office Action does not disclose the claimed feature of reconstructing the original 3-D mesh by collecting the independent mesh object layeres and removing redundant information. This feature does not appear to be mentioned or suggested anywhere in *Li*. Accordingly, *Li* cannot anticipate claim 9.

Claims 2, 3 and 20 each depend from one of independent claims 1 and 19, and are therefore also believed to be patentable for at least the reasons set forth above, and furthermore for the additional combination of features recited in each of these dependent claims.

For example, claim 2 requires that each of the mesh components include at least connectivity information, geometry information and photometry information. Applicants

respectfully submit that *Li* fails to teach this feature. Moreover, it is believed that the Office Action improperly interprets claims 1 and 2 with respect to *Li*. According to the Office Action, the “mesh topology” and “mesh geometry” of *Li* are alleged to be the claimed “plurality of mesh components” (see the Office Action, page 2, section 2, paragraph 1). Next, the Office Action alleges that each of these respective mesh components include connectivity information, geometry information and photometry information, as recited in claim 2. However, this conclusion reached by the Office Action appears to contradict what the Office Action previously alleged with respect to independent claim 1 (*i.e.*, that *Li* discloses a mesh topology component and a mesh geometry component). Furthermore, *Li* does not appear to disclose that each of the mesh topology and the mesh geometry includes connectivity information, geometry information and photometry information because *Li* appears to suggest that the mesh geometry is separate from the mesh topology (see *Li*, the abstract).

Amended claim 3 requires extracting one or more mesh object layers from a 3-D mesh, and dividing the one or more mesh object layers each into the plurality of mesh components. To support the rejection of claim 3, the Office Action alleges: “*Li* ‘737 discloses extracting one or more mesh object (*i.e.*, parts a, and b).” However, in contrast to this allegation in the Office Action, *Li* does not discuss extracting “parts a and b” as mesh object layers from the 3-D mesh and dividing each into the plurality of mesh components. In fact, *Li* only describes “parts a and b” as being two holes in an open surface that is represented by the mesh shown in Figure 1 (see *Li*, column 3, lines 65-67). Furthermore, the allegation that *Li* discloses extracting “parts a and b” as one or more mesh object layers from a 3-D mesh is inconsistent with the previous allegation by the Office Action that the plurality of mesh components are *Li*’s mesh topology data and mesh geometry data. *Li* fails to anticipate claim 3 because each of the features defined by claim 3 are not disclosed in *Li*.

In view of the deficiencies noted above with respect to *Li*, each of claims 1-3, 9 and 19 is believed to recite novel combination of features not found in *Li*. Accordingly, Applicants respectfully request that the rejections of all pending claims under 35 U.S.C. § 102(e) be withdrawn.

Claims 4-7, 10-18 and 20 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over *Li* in view of U.S. Patent No. 5,818,463 to *Tao et al.* (hereinafter, *Tao*).

Applicants respectfully submit that the combination of *Li* and *Tao* fails to render obvious the claimed invention.

With respect to dependent claim 4, the Office first states that *Li* fails to teach reusing information generated by the coded mesh for coding a mesh component that has not yet been coded (see the Office Action, page 3, section 4). Applicants agree with this statement by the Office Action. The Office Action then alleges that it would have been obvious to modify *Li* as taught by *Tao* for the purpose of speeding up processing because it is well known to feed back to a wire-frame synthesizer information generated while a mesh component is coded, which information is used for the next coding mesh component.

The motivation by the Office Action for combining *Li* and *Tao* (i.e., “reusing information will speed up processing,” see the Office Action, page 3, section 4, paragraph 5) cannot be found in either of these documents. To the contrary, it appears that if one were to modify *Li* to include the processes of *Tao*, the resulting system would include additional processes to what is taught by *Li*.

Even if one were to consider, for the sake of argument, that one of ordinary skill in the art would have been motivated to combine the teachings of these two documents, this hypothetical combination would fail to teach every feature of the claims. In particular, Applicants submit that neither *Li* nor *Tao* disclose that each of the mesh components corresponds to a different partition of the 3-D mesh, as set forth by independent claim 1, from which claim 4 depends. *Tao* describes techniques for compressing data representing an animation sequence at a series of discrete time frames for a 3-D object. The “feedback” process of *Tao* only occurs when animation parameter coding is disabled, and if so, a wireframe synthesizer takes the output of the local memory in a mesh encoder, decodes it, and generates a reconstructed mesh of the object (see *Tao*, column 4, lines 16-18 and lines 34-37). *Tao* does not appear to teach or even remotely suggest dividing a 3-D mesh into a plurality of mesh components, wherein each of the mesh components correspond to a different partition of the 3-D mesh. To the contrary, *Tao* appears to teach that data corresponding to an entire mesh is transferred from the mesh encoder to the wireframe synthesizer.

For at least these reasons, claim 4 is believed to be non obvious in view of *Li* and *Tao*. Claims 7, 14 and 16 recite features that are similar to claim 4 and are believed to be

patentable for at least the same reasons discussed above with respect to claim 4. Accordingly, Applicants respectfully request that the rejections of claims 4, 7, 14, and 16 under Section 103 be withdrawn.

With respect to claims 5 and 15, the Office Action states that *Li* “fails to disclose dividing a transmitted bit stream into a plurality of coded mesh, also decoding each and reconstructing a 3-D mesh by synthesizing.” Applicants agree with this statement. Applicants further submit that neither *Li* nor *Tao* teach a demultiplexer for dividing the transmitted bit stream into a plurality of mesh components; ... and a 3-D data synthesizer for synthesizing the plurality of decoded mesh components to reconstruct a 3-D mesh, as defined by claim 15.

In support of the rejections of claims 5 and 15, the Office Action alleges that *Tao*’s Figure 2 teaches “plurality of bit streams being coded (i.e. units 202, 206 and 216) and decoded (i.e. unit 208) and reconstructing a 3-D mesh through multiplexer 218.” Applicants submit that this allegation does not remedy what the Office admits is lacking in *Li*. Nor is this allegation consistent with claimed subject matter as set forth in claims 5 and 15. First, *Tao*’s multiplexer is not a demultiplexer, as claimed. Secondly, decoding 3-D mesh information is described by *Tao* only in connection with a condition when parameter coding is disabled. According to *Tao*, it is during the time that parameter decoding is disabled that a mesh encoder (i.e., *Tao*’s reference 216) outputs a coded mesh to a wireframe synthesizer (*Tao*’s reference 212), which decodes the coded data and generates a reconstructed mesh of the object (see *Tao*, column 4, lines 35-37).

Applicants respectfully submit that neither *Li* nor *Tao* teach or suggest a demultiplexer, as set forth by claim 15. This is because the disclosures of both *Li* and *Tao* are mainly directed to encoding mesh data for transmission, and thus do not discuss details of any particular decoding apparatus, much less a demultiplexer for dividing a transmitted bit stream, as claimed. Nor is any 3-D synthesizer mentioned in either of *Li* or *Tao*. In view of this, Applicants respectfully submit that neither *Li* nor *Tao*, whether taken alone or in combination, teach or suggest the combination of features as defined in claim 15.

Claim 5 is directed to a progressive 3-D information decoding method that requires dividing a transmitted bit stream into a plurality of coded mesh components, decoding each of

the plurality of coded mesh components, and reconstructing a 3-D mesh by synthesizing the plurality of decoded mesh components. As pointed out above, *Tao* does not discuss details of decoding mesh data. Moreover, *Tao* does not discuss or mention that a transmitted bit stream is divided into a plurality of coded mesh components by any of the elements of *Tao*'s Figure 2, particularly those identified by the Office Action as units 202, 206, 208, 216, and (multiplexer) 218.

As to independent claim 10, the Office Action alleges that claim 10 is "substantially similar to claims 1, 3 and 4-5." Applicants do not understand this statement. Simply alleging that a claim is "similar" to other claims is not believed to be a proper condition by itself for showing nonobviousness under 35 U.S.C. § 103(a). MPEP § 2141 states that the standard of patentability to be applied in obviousness rejections should be consistent with that followed in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966). Because the Office has not provided any explanation as to why claim 10 is rejected other than alleging its similarity to other claims, it is respectfully submitted that the Office has not fulfilled its burden of enunciating a factual basis for rejecting claim 10 that is consistent with the Office's policy set forth in MPEP § 2141. At least for this reason, Applicants respectfully submit that the rejection is improper and should be withdrawn.

Furthermore, independent claim 10 requires, *inter alia*, extracting one or more mesh object layers from a 3-D mesh and dividing each of the mesh object layers into a plurality of independent mesh components. Applicants respectfully submit that neither *Li* nor *Tao* disclose or suggest this feature. *Tao* does not appear to disclose any process of extracting and dividing 3-D mesh object layers. *Li* describes that a plurality of mesh layers may be formed from a 3-D mesh to provide incremental convergence from a coarse (base) version of a mesh to the original 3-D mesh (see *Li*, column 11, line 50 to column 13, line 49). However, *Li* does not mention or suggest extracting one or more mesh object layers from a 3-D mesh and dividing each of the mesh object layer into a plurality of independent mesh components, as defined in claim 10. In contrast, *Li* describes forming a plurality of successive mesh layers (" M_n to M_0 ," see *Li*, column 11, line 64 to column 12, line 15), wherein each successive layer is essentially a mesh data subset of a previous layer's data set (in the direction from "original"

to “base”). Applicants respectfully submit that claim 10 is patentable at least because *Li* and *Tao* fail to teach each and every feature recited by claim 10.

With respect to independent claims 12 and 17, the Office Action alleges that *Tao* teaches “a 3-D data analyzer for receiving a 3-D mesh and reconstructing the input 3-D mesh into a plurality of mesh (see col. 2, lines 58+ of *Tao* ‘463).” Applicants disagree. Claim 12 defines, *inter alia*, a 3-D data analyzer for receiving a 3-D mesh and reconstructing the input 3-D mesh into a plurality of mesh components. Claim 17 at least requires a 3-D mesh object layer analyzer for receiving a 3-D mesh and dividing an input 3-D mesh into one or more independent mesh object layers. The portion of *Tao* cited in the Office Action describes formation of a plurality of mesh, wherein each mesh represents a different region of an object. In this passage, *Tao* is merely describing the creation of one or more mesh that respectively represent one or more regions of an object. This contrasts with what is required by claim 12, which requires that a 3-D mesh is reconstructed into a plurality of mesh object layers, and by claim 17, which defines a 3-D analyzer for receiving a 3-D mesh and dividing an input 3-D mesh into one or more independent mesh object layers. Applicants therefore respectfully submit that claims 12 and 17 are patentable over *Tao* and *Li* at least because neither *Tao* nor *Li* teach or suggest these claimed features.

To establish a *prima facie* case of obviousness of a claimed invention, all the features of the claim must be taught or suggested by the prior art. See MPEP § 2143.03. It is respectfully submitted that neither *Li* nor *Tao*, whether considered individually or in any combination thereof, teach or suggest all of the features of independent claims 5, 10, 12, 15, and 17, and hence their respective dependent claims 6-7, 11, 13-14, 16, and 18.

Based on the foregoing, Applicants respectfully submit that neither *Li* nor *Tao* anticipate nor render obvious the claimed invention. Accordingly, Applicants respectfully request that the rejections of all claims under Sections 102 and 103 be withdrawn.

Conclusion

For at least the foregoing reasons, Applicants respectfully submit that the present patent application is in condition for allowance. An early indication of the allowability of the

present patent application is therefore respectfully solicited. If the Examiner believes that a telephone conference with the undersigned would expedite passage of the present patent application to issue, the Examiner is invited to call the number below.

Respectfully submitted,

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Attachment to Amendment dated May 28, 2002 Showing Changes
(Brackets show deletions and underlining shows additions)

In the Claims :

Claims 1, 3 and 5 have been amended as follows:

1. A progressive 3-D mesh information coding method comprising the steps of:
(a) dividing a 3-D mesh into a plurality of mesh components, wherein each of the mesh components corresponds to a different partition of the 3-D mesh;
(b) coding each of the plurality of mesh components; and
(c) multiplexing the plurality of coded mesh components into a compressed bit stream and transmitting the compressed bit stream.

3. The progressive 3-D mesh information coding method as claimed in claim 1, wherein the step (a) comprises the substeps of:
(a1) extracting one or more mesh object [layeres] layers from a 3-D mesh; and
(a2) dividing the one or more mesh object [layeres] layers each into [a] the plurality of mesh components.

6. The progressive 3-D mesh information decoding method as claimed in claim 5, wherein the step (a) comprises the substeps of:
(a1) classifying the transmitted bit stream into one or more decoded mesh object [layeres] layers; and
(a2) dividing each of the one or more decoded mesh object [layeres] layers into a plurality of mesh components.

9. [The progressive 3-D mesh information coding/decoding method as claimed in claim 8, further comprising the step of] A progressive 3-D mesh information coding/decoding method comprising the steps of:
(a) extracting one or more independent mesh object layers from a 3-D mesh;
(b) independently coding and transmitting the one or more mesh object layers;

(c) obtaining one or more independent mesh object layeres by decoding one or more of the independently coded and transmitted mesh object layers; and

(d) reconstructing the original 3-D mesh by collecting the independent mesh object [layeres] layers and removing redundant information[, after step (c)].

13. The progressive 3-D mesh information coding apparatus as claimed in claim 12, wherein the 3-D data analyzer comprises:

a 3-D mesh object layer analyzer for dividing the input 3-D mesh into one or more mesh object [layeres] layers; and

a plurality of mesh component analyzers for again dividing each of one or more mesh object [layeres] layers into a plurality of mesh components.

17. A progressive 3-D mesh information coding/decoding apparatus comprising:
a 3-D mesh object layer analyzer for receiving a 3-D mesh and dividing an input 3-D mesh into one or more independent mesh object [layeres] layers;

one or more mesh object layer coders for independently coding and transmitting one or more mesh object [layeres] layers; and

one or more mesh object layer decoders for decoding one or more independent mesh object [layeres] layers which are independently coded and transmitted, to obtain one or more independent mesh object [layeres] layers.

18. An independent and progressive 3-D mesh information coding/decoding apparatus as claimed in claim 17, further comprising a 3-D mesh object layer synthesizer for synthesizing one or more independent mesh object [layeres] layers and removing redundant information to reconstruct the original 3-D mesh.

19. A progressive 3-D mesh information coding/decoding apparatus comprising:
a 3-D mesh object layer analyzer for receiving a 3-D mesh, dividing an input 3-D mesh into one or more mesh object [layeres] layers, and again dividing each mesh object layer into a plurality of independent mesh components;

a plurality of mesh component coders for independently coding and transmitting the plurality of independent mesh [object layers] components; and

a plurality of mesh component decoders for decoding the plurality of mesh components which are independently coded and transmitted, to obtain a plurality of independent mesh components.